



Promoting Students' Global Perspectives Through a Gamified e-Learning Platform

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With the rapid growth of internationalization in tertiary institutions worldwide, the development of students' global perspectives has attracted the attention of many universities. However, this development is a challenging one due to the complicated nature of global issues and their incompatibility with traditional subject-specific boundaries of classroom teaching. Through two eTournaments organized on a proprietary gamified e-learning platform named "PaGamO," this study examined participating students' learning experience and their change of global perspectives due to their participation in the eTournaments. Data were collected before and after the two eTournaments, and 217 survey responses were considered to be valid and were further analyzed. The findings showed that participating students achieved the satisfaction level of enjoyment ($M = 3.62$) and their awareness of the United Nations Sustainable Development Goals (SDGs) ($M = 3.96$) had been improved. In addition, the findings also revealed that 1) students enjoyed and perceived a better understanding of the SDGs in terms of perceptual dimensions like value-oriented and partnership-oriented, rather than the global issues about substantial threats or environmental issues; 2) the "intrapersonal effect" of students had been significantly reduced after the eTournaments; 3) positive significant correlations were found between the level of enjoyment and frequency of question-attempt in relation to the change of cognitive knowledge and interpersonal social interaction. The findings of this study offered some possible insights into students' gameplay experience concerning dimensions of global perspectives and also support the findings of prior research on how gamified e-learning platforms could contribute to the development of students' global perspectives.

Keywords: gamified learning, global perspective, online learning, e-learning, sustainable development goals

INTRODUCTION

Internationalization in higher education has been accelerating rapidly in the past 40 years (Guo et al., 2021). This "process" (Knight, 2004) increasingly impacts higher education institutions in the world, which facilitates research collaborations, staff and students' mobility, and cultural and economic exchanges (Seeber et al., 2020). While internationalization could be applied to a multi-level organization and sectors, internationalization in higher education could be generally defined as "the process of integrating an international, intercultural or global dimension into the purpose, functions or delivery of post-secondary education" (Knight, 2004). The definition of internationalization had been modified several times (Knight, 1994, Knight, 2004; Guo et al.,

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2021), and the recent outbreak of COVID-19 has led scholars to believe that the current framework is incompatible (Taşçı, 2021). However, these revised definitions and approaches (e.g., competency approach) remained linked and “complementary” (Knight, 2004), reflecting on the dynamic shifts in the “complex world” (Leask, 2015, 27). The reform of definitions may continue as time passes (de Wit and Altbach, 2021), but the core rationale of internationalization emphasizes a sense of relationships between nations, diverse cultures, and global issues at all levels, including institutional, local, national contexts.

From an individual perspective, one of the approaches in describing internationalization is the competency approach, which emphasizes how to develop internationalization in terms of knowledge, skills, and attitudes among students in the globalized world (Knight, 1994). Graduate attributes are a typical example of this approach to link up with the concepts of internationalization and bringing theories into the practices, as the internationalization of curriculum (Leask, 2015, 53). While this approach addresses human growth rather than organizational changes, many institutions use the term “global perspectives” and “international perspectives” explicitly in their websites to represent this as a generic skill for recognizing and respecting the inter-connection of life in a globalized world (Leask, 2015, 55).

Internationalization is frequently viewed from a global perspective rather than as a regional issue (Braskamp, 2009). It is because through understanding the interconnectedness of global issues, students could develop more capacities to address such problems and increase their own competitiveness in the economy (Baildon et al., 2018). It is therefore vital for university education to prepare students to become future leaders with global perspectives, which enable them to address the world’s pressing challenges and improve their intercultural social skills.

Although the importance of possessing internationalization through global perspectives had been highlighted by previous works (Warner, 2017; Medora et al., 2020), the term “global perspective” is often considered as an alternative learning outcome of a program rather than an independent learning task (Smith and Yang, 2017) to be achieved by students. Furthermore, most studies conducted about the promotion of global perspectives mainly focused on the teacher-led internationalization activities, such as Education Abroad Program (Hudson and Tomás-Morgan, 2019), video conferencing (Greenwood, Honey, and Clancy, 2016), or university culture (Shephard, Bourk, Miroso, and Dulgar, 2016), and did not address how students acquired their global perspectives through self-directed learning.

Internationalization can be accomplished through emerging knowledge from cross-cultural contexts into the curriculum (Knight, 1994; Seeber et al., 2020). However, integrating global perspectives as an effective means of internationalization into the formal curriculum had faced some challenging issues. First, global perspectives are often undervalued or incompatible with the traditional subject-specific boundaries of classroom teaching. More boundless learning opportunities should be offered to students to widen their horizons, whereas it may affect the professional recognition of the corresponding degree program

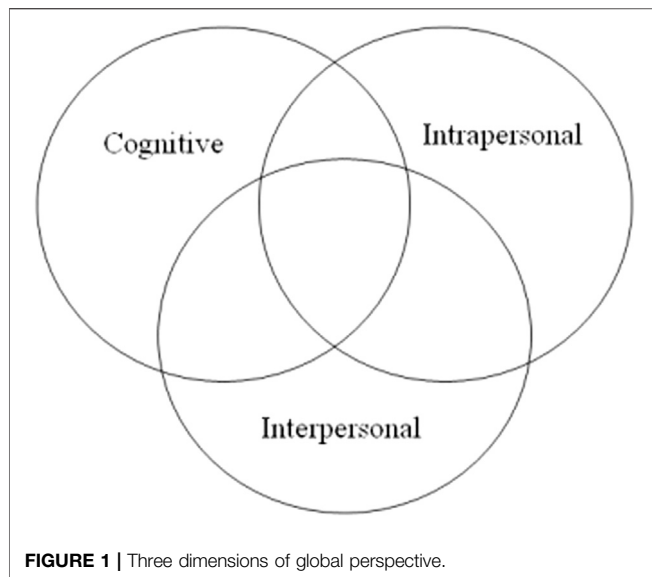
(Enonbun, 2010). Second, the selection of global issues is a difficult task—the content should involve the mutual concerns of both developing and developed countries, and an option should be provided to work in a field that crosses all national boundaries, cultures, demographics, and regions (Evans, Ingram, MacDonald, and Weber, 2009). For example, Kopnina (2015) suggested that well-developed countries are more interested in keeping economic growth countries, while their citizen-consumers do not want to scarify themselves for environmental protection, climate change, or other relevant SDGs. Similarly, it is not realistic to ask students from developing countries to talk about “decent work” when they have to face the challenges of survival, like poverty and hunger, every day. It is challenging to integrate the thoughts of students with multidisciplinary and multicultural backgrounds. As a result, despite the importance of possessing global perspectives is highlighted by many researchers, few universities actually dedicate the effort and resources to promote global perspectives on a large scale. Most students could only develop global perspectives themselves through overseas exchange or intercultural interaction at an individual level, without any systematic school coordination (Evans et al., 2009).

Addressing the above concerns, the idea of Internationalization at Home (IaH) was proposed by scholars, which aims to educate students in local learning environments by incorporating international and intercultural components into the formal and informal curricula. This approach, as classified in prior work (Barbosa et al., 2020), is thought to improve “virtual mobility” by providing a technology-assisted environment, an alternate approach for students to collaborate globally, and therefore better promote students’ global perspectives. Therefore, this study aims to explore the role of technology-assisted challenge-based learning in promoting students’ global perspectives. In this study, a gamified e-learning platform, “PaGamO” was used. It allowed students with multidisciplinary and multicultural backgrounds to work together in teams and compete on a virtual map with their knowledge of the 17 United Nations (UN) Sustainable Development Goals (SDGs). The 17 SDGs were agreed upon by world leaders in 2015 to represent the universal challenges of humans from a global perspective (United Nations, 2015).

LITERATURE REVIEW

Definition and Dimensions of the Global Perspective

Global perspective refers to the nature of a study that is globally oriented, instead of the view that is being confined to the cultural or political preferences and inclinations of the particular country (Hua, 2008). Previous researchers tried to give a detailed description of what global perspectives should cover. Some researchers focused on its significant dimension, emphasizing the range of global topics about which people should be informed, such as universal human values that transcend group identity (e.g., equality, justice, and liberty), and persistent global issues



and problems (e.g., poverty or femininity) (Kniep, 1986). These researchers focused more on knowledge and information, while the development of global perspectives is considered as a cognition process of gaining understanding about different global knowledge, value, and information.

Case (1993) also agreed with the substantial dimension, yet he stepped forward and extended the discussion of global perspectives to “perceptual dimension,” which refers to “various intellectual values, dispositions, and attitudes that distinguish a parochial perspective . . . from a broad-minded perspective” (P.320). Case (1993) outlined five main perceptions of developing students’ global perspectives, namely, 1) open-mindedness; 2) anticipation of complexity; 3) resistance to stereotyping; 4) inclination to empathize; 5) non-ethnocentrism (thinking one’s group is superior to others). Case’s idea is further developed into the concept of intercultural competence, which refers to the “modes of thought, sensitivities, intellectual skills, and explanatory capacities” (Deardorff, 2009, p.443). In this view, the development of global perspectives is not just cognitive but also involves the psychological and emotional development of dispositions, ethical position, open-mindedness, and multicultural attitude. It thus involves how individuals deal with cultural diversity and how to make sense of the world.

Integrating the substantial and perceptual dimensions of the global perspectives, Braskamp et al., 2014 conceptualized them into three domains: cognitive, intrapersonal, and interpersonal (Figure 1).

In Braskamp’s view, the cognitive domain is about intercultural knowledge, which includes “individual knowledge and knowing with greater complexity and taking into account multiple cultural perspectives” (Braskamp, 2014, p.3). The intrapersonal domain focuses on individual awareness and how they integrate their own personal values and self-identity internally. The interpersonal domain is more about individual attitude and behavior. It is centered on one’s willingness to

interact with outgroup cultures and their acceptance of others (Braskamp et al., 2014).

Global Learning for Global Perspectives and SDGs

At the university level, students’ global perspectives could be developed through global learning. Global learning is the learning process where students with diverse cultural backgrounds make collaborative efforts to tackle and resolve the complicated problems that transcend the national borders (Landorf and Doscher, 2015). And it was recognized as one of the ways to aid institutional internationalization (Ng and Nyland, 2016). Students could develop individual competence through global learning by exploring and considering different points of view.

During the global learning activity, the students would share their own viewpoints as a member of a virtual team, which is known as social presence (Wang, 2009). Also, global learning should help develop global awareness, knowledge of the world’s complexity, and interrelatedness. It could also facilitate the students’ collaboration since they would acknowledge that they are too complex for any single person, group, discipline, or approach to solve alone.

Although the concept of global perspectives is an individual capacity, its development is not context-independent. There is a need to choose global-awareness issues that the students could explore and integrate different perspectives. In this regard, the 17 SDGs serve as good examples for students to explore their implications.

The 17 SDGs are the core of “The 2030 Agenda for Sustainable Development” of the UN, which serves as a “blueprint to achieve a better and more sustainable future for all,” instead of the narrow consideration of the particular country. All SDGs require the collaborative actions of all countries—developed and developing—in a global partnership (United Nations, 2015), such as ending poverty, reducing inequality, or tackling climate change. These SDGs had been well noted in previous literature that could be used as an agent to call upon to help contribute to the challenges and goals in internationalization (de Wit and Altbach, 2021).

Through a prolonged discussion in the UN, the 17 SDGs were agreed upon by all world leaders and were adopted at the UN Sustainable Development Summit in September 2015 (United Nations, 2015). The goals are included in **Table 1**.

It is worth noting that learning SDGs in the university setting is a complicated task. It often involves a deep conflict when attaining different SDGs at the same time. For example, Hickel (2019) suggested that continued global industrial growth in SDG 8 may not be reconcilable with ecological sustainability goals (SDG 12–15) due to the global eco-economic decoupling in recent years. Also, economic growth (SDG 8) may worsen the goal of inequality reduction or other sustainability objectives. Thus, the implementation of the SDGs needs to balance conflicting positions and compromise, such as exploring the possibility of ecotourism or global recycling industry, which are generally considered as the typical example of seeking a

balance between economic benefits for resident hosts or consumers' benefits and environmental protection against the additional costs (Alexander and Whitehouse, 2004).

Moreover, the teaching and learning of global perspectives and SDGs is not an easy task. Previous literature showed that most teachers focused on the development of substantial dimensions only. Merryfield, 1998, for example, suggested that most teachers focused on the particular topics of culture and history, such as human rights, the slave trade, or child labor. On the other hand, Kirkwood, 2002 suggested that most teachings about world-mindedness tended to highlight the cultural universals, such as loving families, self-esteem, and personal and cross-cultural appreciation. At the university level, however, the knowledge of people and places is clearly not enough. Although the introductory courses about global perspectives could be the starting point for raising students' awareness of others' perspectives, the lecturer is difficult to help students develop desirable attitudes and sensibilities, such as open-mindedness, tolerance, empathy, or consciousness of their own national orientations, as well as their worldview.

Promoting Global Perspectives Through a Gamified e-Learning Platform

As mentioned before, one of the challenges of promoting global perspectives is that most global issues are extremely complicated because of their cross-disciplinary, cross-cultural, demographical, and regional nature. Moreover, it does not entirely fit the formal curriculum. Teachers could only use the example of global issues for instruction or to encourage students to apply their professional knowledge to tackle global problems. At the same time, students would consider whether the learning content could benefit their academic achievement or professional recognition. Thus, it is difficult to motivate them and build up their awareness of global perspectives outside the official curriculum.

Addressing the above limitations, a gamified e-learning platform was offered as an informal internationalization curriculum for students. The benefits of gamified ICT-enhanced teaching have been frequently reported by different researchers, such as increasing students' motivation and engagement (Koivisto and Hamari, 2019), empowering students with low self-efficacy, and even facilitating the development of critical thinking (Turkay et al., 2014; da Rocha Seixas et al., 2016). Similarly, it is also reported as an effective tool to introduce global perspectives to students beyond the traditional classroom. Previous studies suggested that gamified e-learning platforms are effective in teaching non-subject knowledge, such as leisure reading (Mak et al., 2019), traffic safety (Riaz et al., 2019), or civic engagement (Hassan, 2017). Not only could the gamified e-learning platform motivate students through the peer-pressure or team collaboration, but it also offers external motivation (i.e., points, achievements, or ranking) that makes students more committed to learning and achieve higher levels of flow experience during the gameplay (Mak et al., 2019).

METHODOLOGY

As noted above, the need for global perspectives as one of the research indicators of internationalization had been documented earlier (McCabe, 1994; Leask, 2015), and that the intervention was frequently through formal teacher-led activities to promote students' global perspectives. This research bridges the void by using gamified SDGs content to help students develop global perspectives. As a result, this research investigates the effectiveness of using an eTournament on the gamified e-learning platform "PaGamO" to help students gain global perspectives. It also examined students' perceptions of their gameplay experience. A central question of this study is

To what extent could the gamified e-learning platform help students develop their global perspectives?

To guide the study, the following three research questions are proposed:

- RQ1. What are students' perceptions of their gameplay experience and improvement of SDG awareness?
- RQ2. How do the students' global perspectives change after the eTournament?
- RQ3. What is the correlation between students' gameplay experience and the change of global perspectives in the eTournament?

Research Design

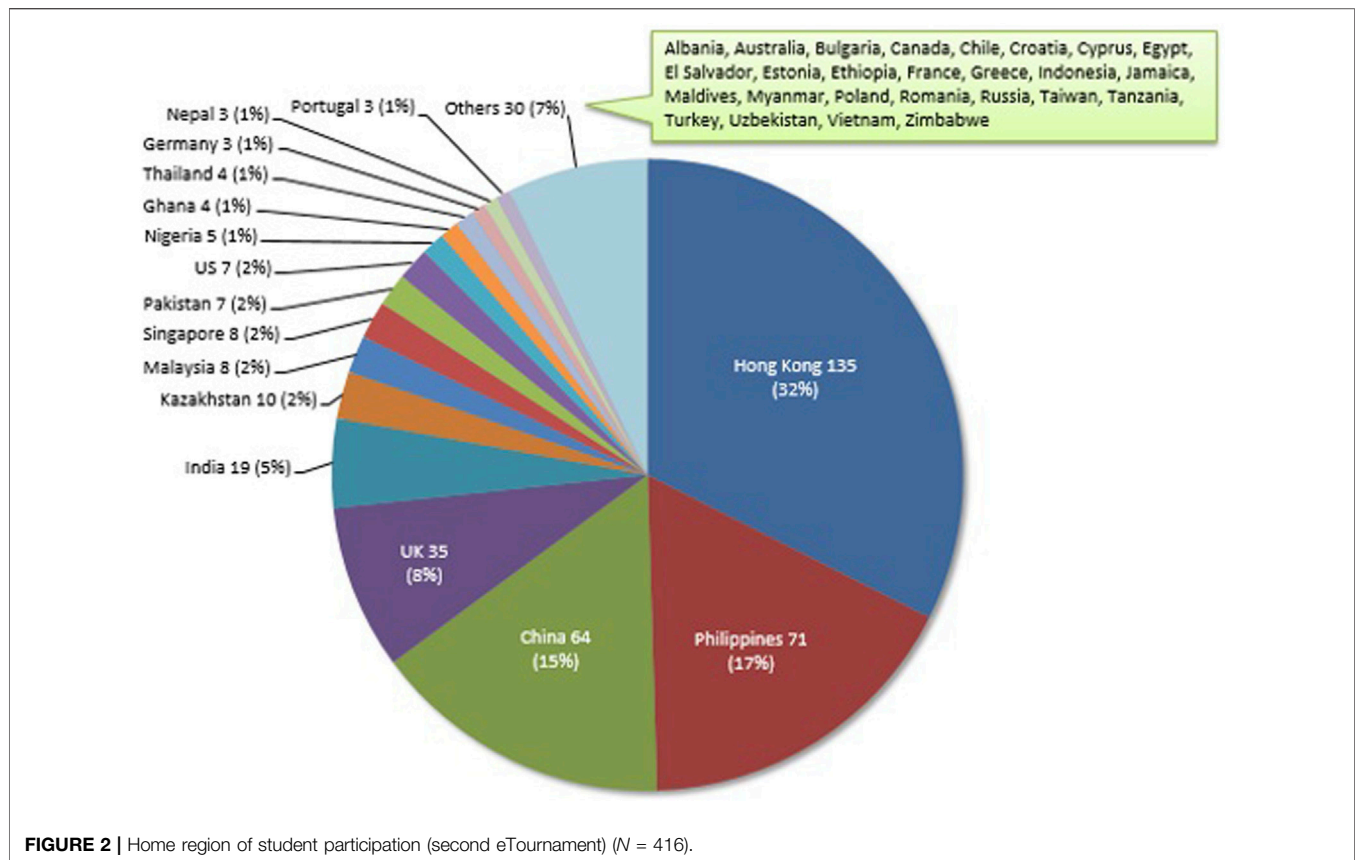
This study adopted a pre-test, post-test quasi-experimental design. A quantitative approach aims to help researchers grasp the pattern of response among the large population (Kendall, 2008). Since this study involved more than two hundred students, the quantitative approach allows us to explore how the gamified e-learning platform works well in the development of students' global perspectives. Second, it allows the researchers to investigate students' feedback from a larger sample size for more generalizable results (Oppenheim, 1992).

The SDGs eTournament

This study involved two eTournaments; they both had a similar design and both aimed to 1) allow students from different parts of the world to learn to work together online (Online Teams) and complete specific tasks, 2) let students learn about the 17 UN Sustainable Development Goals (SDGs) through the game platform, and 3) allow students to learn about the different cultures and background of their teammates (Hong Kong Baptist University, 2020). Two eTournaments were held in the spring of 2019 and spring of 2020, respectively. Both eTournaments had two stages which will be described in the following.

The Gamified Platform

"PaGamO" was used to bridge the gap between informal and formal global perspective learning. PaGamO was developed by a professor from the National Taiwan University, which allows players to learn and compete with each other in an online virtual map by answering preset questions. PaGamO allows teachers to



prepare their own question bank according to the learning objective (Hong Kong Baptist University, 2020). Also, the PaGamO system provided a convenient way to explore different learning analytic features like the frequency of question attempts for further analysis.

Game Content

The questions about the SDGs are multiple-choice questions (MCQ) which were developed through two approaches. On the one hand, university students from all over the world were invited to submit SDG questions in the 2018 SDG Questions Creation Contest. The expert judges at UNESCO Hong Kong Association reviewed all questions in the contest to ensure their validity of fitting the learning objective of the global perspectives. In the contest, 706 valid SDG-related questions were prepared by 117 university students from 10 institutions in Hong Kong, Australia, India, the Philippines, and Singapore. On the other hand, experts from UNESCO Hong Kong Association were invited to develop the SDG questions so that an SDG questions bank of about 1,400 questions was created.

Preparation Stage

Stage 1 is the preparation stage, where all students were invited to do online discussions in a pre-assigned virtual team so that they could get familiar with each other and work out the strategies for the gameplay. During Stage 1, each team was asked to choose their team leader, PaGamO game characters, and discuss their game strategy for Stage 2.

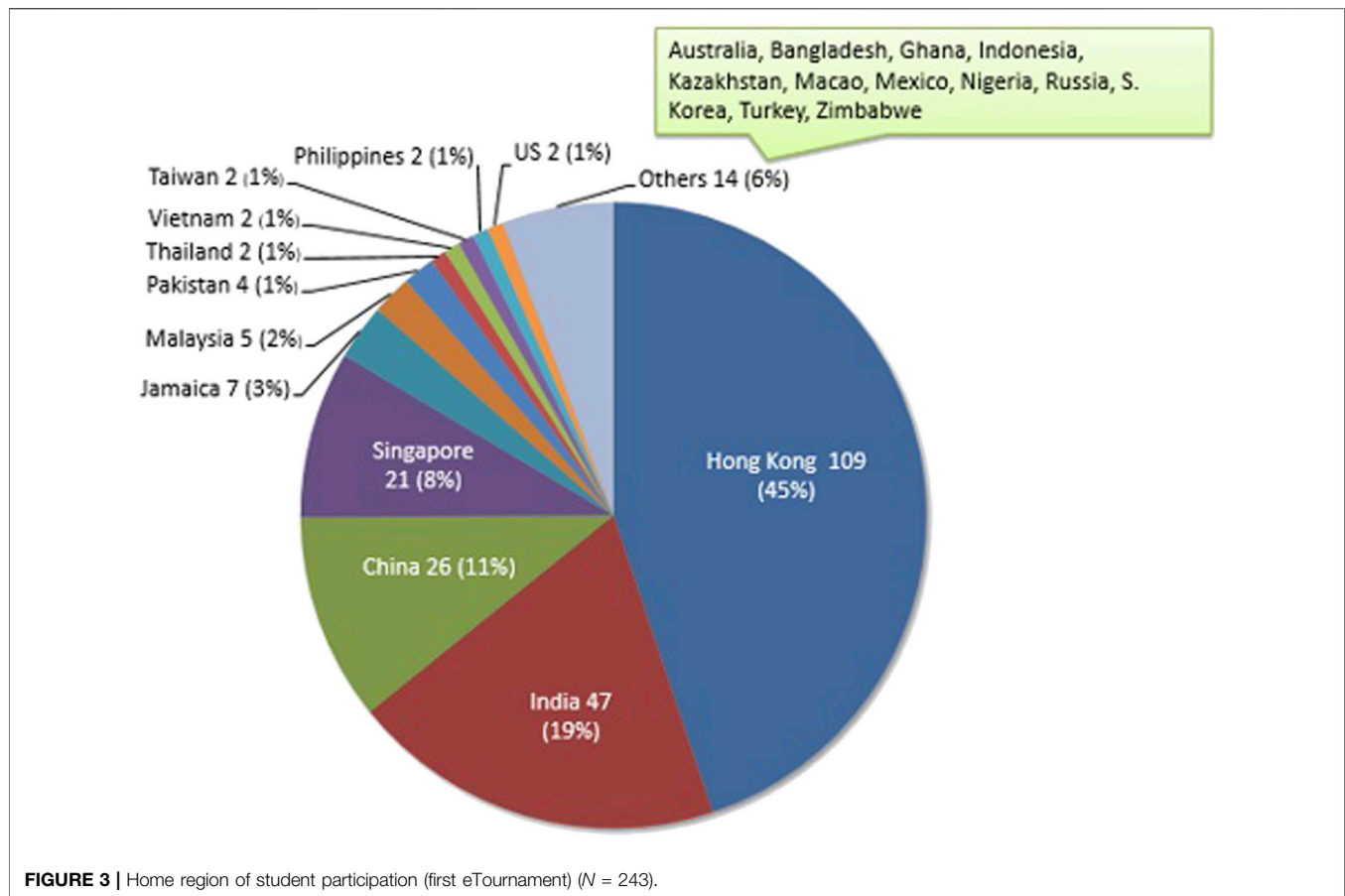
Game Play Stage

Stage 2 is the gameplay stage, where teams had to compete with each other on the virtual map of PaGamO by answering SDG questions. The questions were put into a single question pool and were assigned to students randomly in the first eTournament, while in the second eTournament, the questions of each SDG were put into different sets, and the students could choose to answer particular sets of SDG questions.

Sampling

With the involvement of four local partner institutions and 13 international collaborators, this study invited students from universities all over the world. In general, all university students, ranging from sub-degree to doctoral level, are eligible to join the eTournament. Each team consisted of four to five members, and all team members were assigned to each group randomly. To ensure student diversity, no more than two students from the same institution or region would be grouped together in each team.

To minimize the non-response bias among students, two criteria were used in the data filtering process. First, the students would not be counted if their frequency of question attempts (the sum of attack-action and land-training action in PaGamO) was less than ten. Second, the students would be considered as having survey fatigue if they made “straight-line responses” (i.e., giving answers down the same column) over fifteen questions. Previous literature suggested that survey fatigue



would lead to non-response bias and cover the significant findings (Lavrakas, 2008).

Data Collection and Instrument

This study has been approved by the university's Research Ethics Committee. At the first survey, participants volunteered for the study and received their informed consent. Data were collected before and after the eTournament, with 8-day (2019 run) and 16-day (2020 run) gaps between the two surveys. All participating students were invited to fill in the pre-survey while those who finished the final stage of the eTournament were invited to complete the post-survey about their learning experience of global perspectives, level of enjoyment, and perceived improvement of SDG awareness. They would earn some bonus points for the eTournament after completing the survey. Qualtrics, an online survey tool, was used to collect the data. After the eTournament, the question attempts were extracted from PaGamO as part of the learning analytic function.

The global perspectives were measured by a shortened version of the Global Perspective Inventory (GPI), which was developed by Braskamp and his colleagues in 2014. Since the two eTournaments were brief and had no direct effect on individual behavior or life-long social responsibility, the dimension "Social Responsibility" was excluded from the survey.

The shortened version of GPI in this study consists of 22 items, which categorized global perspectives into five dimensions: 1)

cognitive knowing, 2) cognitive knowledge, 3) intrapersonal identity, 4) interpersonal affect, and 5) interpersonal social interaction (Braskamp et al., 2014). A 5-point Likert scale was used in the surveys, and students were invited to comment on each statement according to their experience, with one indicating "strongly disagree" and five indicating "strongly agree."

In the survey, the demographic and other self-reported data such as gender, contact email, level of enjoyment, and perceived improvement of SDG awareness were also collected. A descriptive statistical analysis was performed using the data from PaGamO's question attempts.

Data Analysis

First, the Cronbach's alpha of each dimension of GPI was calculated in order to ensure internal consistency. Second, addressing RQ1, the descriptive statistical analysis was conducted on the mean scores of 1) level of enjoyment; 2) perceived improvement of SDG awareness; (3) frequency of question-attempt (including the student's attempt to attack others, expand territory, and train his own land), which explicitly indicated students' experience during the gameplay. Third, the paired-sample *t*-test was conducted to examine whether students' global perspectives had significant changes before and after the eTournament. Lastly, the correlation test was conducted between the global perspectives and students' experience during the gameplay.

TABLE 1 | List of the SDGs.

SDG 1	No Poverty
SDG 2	Zero Hunger
SDG 3	Good Health and Well-being
SDG 4	Quality Education
SDG 5	Gender Equality
SDG 6	Clean Water and Sanitation
SDG 7	Affordable and Clean Energy
SDG 8	Decent Work and Economic Growth
SDG 9	Industry, Innovation, and Infrastructure
SDG 10	Reducing Inequality
SDG 11	Sustainable Cities and Communities
SDG 12	Responsible Consumption and Production
SDG 13	Climate Action
SDG 14	Life Below Water
SDG 15	Life On Land
SDG 16	Peace, Justice, and Strong Institutions
SDG 17	Partnerships for the Goals

FINDINGS

At the start of the two eTournaments, there were a total of 659 students from 46 home regions (see **Figures 2, 3**).

263 students finished all the stages and filled in both pre- and post-eTournament surveys, and 198 responses remain valid after the data filtering process mentioned above.

The internal reliability of the GPI is first tested. The result is shown in **Table 2**.

In this table, the subscale with Cronbach alpha over 0.7 is generally considered as acceptable (Nunnally, 1978) while 0.5 Cronbach alpha is also legitimate and acceptable with a short scale (Dall'Oglio et al., 2010). Since the Cronbach Alpha in subscales "intrapersonal identity" and "interpersonal social interaction" only consist of three and four items, respectively, the GPI in this study is thus considered as reliable for further analysis.

Students' Gameplay Experience in PaGamO

To examine the perceived effectiveness of the eTournaments, this study explored students' feedback on the eTournament through three variables: 1) level of enjoyment in the eTournament; 2) perceived improvement of SDG awareness after the game; and 3) frequency of question-attempt. The result is shown in **Table 3**.

Overall, the students had a moderate level of enjoyment, which gave the mean score of 3.62 for the item "level of enjoyment in the eTournament." By contrast, they gave a higher mean score of 3.75

for the perceived improvement in their SDG awareness after the eTournament.

Regarding the students' autonomy of selecting SDG, the students in the first eTournament ($N = 99$) were assigned SDG randomly, while the students in the second eTournament ($N = 118$) were allowed to choose one. An independent samples *t*-Test was conducted to see if there is any significant difference.

Table 4 shows that students who could freely choose their SDG would have a higher level of enjoyment, increased from 3.09 to 4.06 ($t(215) = -8.17, p < 0.05$). Similarly, they reported a higher score ($M = 4.40$) than students in the first eTournament ($M = 2.98$) in terms of "perceived improvement about their SDG awareness" ($t(215) = -8.968, p < 0.05$).

To further examine the relation between students' level of enjoyment and the effectiveness of eTournament on different SDGs, this study further examined how the students' scores were distributed differently across 17 SDG in the second eTournament ($N = 118$).

Figures 4, 5 show that the awareness improvement in SDGs 16 ($M = 5.00$), 17 ($M = 5.00$) and 3 ($M = 4.71$) was most significant and that in SDGs 2 ($M = 3.89$), 13 ($M = 4.00$), 4 ($M = 4.13$) and 8 ($M = 4.13$) was least significant.

The students enjoyed most in SDG 16 ($M = 4.75$), 17 ($M = 4.40$), and 1 ($M = 4.33$), but the least in 8 ($M = 3.75$), 9 ($M = 3.75$) and 11 ($M = 3.75$).

Before the study, it was assumed the students would enjoy more and perceive more improvement in SDG awareness if they chose to answer the questions related to particular SDG(s) more frequently. However, it is interesting to find that students in some SDGs play the game more frequently but feeling bad, and vice versa. For example, students in SDG 2 (Zero Hunger) reported a higher frequency of question-attempt ($M = 207$), but they give a lower score in the perceived improvement of SDG awareness ($M = 3.89$). By contrast, students with SDG 10 (Reduced inequalities) have a relatively high score in the improvement of SDG awareness, whereas there was very few question attempts ($M = 94$).

Change of Global Perspectives After the eTournament

To examine the change of students' global perspective, a paired-sample *t*-test on the pre- and post-survey results was conducted. The findings are shown in **Table 5** and **Figure 6**.

As shown in **Table 5**, although the mean score of cognitive knowledge and interpersonal social interaction have been slightly increased after the eTournament, the changes of most sub-scales of global perspectives did not reach the significant level, except "intrapersonal affect." It is surprising to observe that "intrapersonal effect" was reduced from 4.35 to 4.16 after the eTournament, which indicates that the students show less acceptance of others' cultural perspectives and have a lower degree of emotional confidence to manage the intercultural conflict after the eTournament.

On the other hand, to examine the impact of SDG allocation on changes in students' global perspective, an independently sampled *t*-Test was conducted. The result is shown **Table 6**.

TABLE 2 | Internal reliability of GPI.

	Number of items	Cronbach alpha (pre-survey)	Cronbach alpha (post-survey)
Cognitive knowing	7	0.721	0.732
Cognitive knowledge	5	0.775	0.817
Intrapersonal identity	3	0.607	0.646
Intrapersonal affect	3	0.779	0.726
Interpersonal Social interaction	4	0.537	0.582

Comparing with students of the first eTournament ($M = 0.105$), the mean difference before and after the eTournament has a significant decrease ($M = -0.188$) in terms of “cognitive knowledge” ($t(208) = 3.26, p < 0.05$). By contrast, a significant increase in “interpersonal social interaction” among students in the second eTournament (0.144) is observed, while the students’ score dropped 0.283 in the first eTournament. Second, both groups of students reported a lower score in “intrapersonal affect” after the eTournament, while the decrease is significantly higher among students in the first eTournament (-0.498) than those in the second eTournament (-0.225) ($t(208) = -4.15, p < 0.05$).

Students’ Perception, Frequency of Question-Attempt, and Global Perspective

To examine how students’ learning experience affects their global perspective, this study conducted a Pearson’s correlation test between the “change of students’ global perspectives before and after the eTournament” and different variables about students’ gameplay. The result is shown in **Table 7**.

This shows that the frequency of question-attempt of students has a significant correlation with the change of students’ global perspectives in terms of “cognitive knowledge” ($r = 0.250, p < 0.05$), “intrapersonal identity” ($r = 0.167, p < 0.05$), “intrapersonal affect” ($r = 0.265, p < 0.05$), and “interpersonal social interaction” ($r = 0.211, p < 0.05$).

The level of enjoyment is also found to have a significant correlation with “cognitive knowledge” ($r = 0.167, p < 0.05$) and “interpersonal social interaction” ($r = 0.177, p < 0.05$). However, the “perceived improvement of SDG awareness” has no correlation with all dimensions of global perspective, except “interpersonal social interaction” ($r = 0.239, p < 0.05$).

The result shows that the students who played PaGamO more frequently could gain more understanding about various cultures and their impact on our global society. They would have a higher degree of engagement with peers from other cultures and develop a higher degree of cultural sensitivity in living in pluralistic settings.

DISCUSSION

The results of the analyses indicate that students’ gameplay experience is correlated with the development of students’ global perspectives, while the gamified platform also created a desirable context for developing the global perspective. In this

TABLE 3 | Level of enjoyment, perceived awareness, and frequency of question attempts.

	Mean	SD
Level of Enjoyment	3.62	0.99
Perceived improvement of UN-SDG awareness	3.75	1.36
Frequency of question attempts	145.0	74.7

section, the robustness of these findings is further discussed in comparison with existing literature.

Students’ Gameplay Experience and Perception in Different SDGs

The above findings revealed that the eTournament has basically met its primary objective: to improve students’ awareness of different SDGs through the eTournament. However, its change is probably affected by the nature of SDGs.

In the past, Begler (1993) suggested that knowledge inherent in a global perspective could be divided into substantive (Knowledge inherent in a global perspective) and perceptual domains (an array of intellectual values, dispositions, and attitudes). Begler suggested that perceptual domains offered the “lens” through which the substantive domain is viewed, while this study further revealed that these natures would also affect the effectiveness of the gamified learning experience. In **Figure 4**, it is observed that there is less improvement of SDG awareness in the substantive domains (i.e., SDG 2 “Zero hunger” and 13 “Climate Action”). It is probably because the students already had a relatively high awareness about the substantive challenges (i.e., impact greenhouse effect or global warming) through the advertisement of different non-governmental organizations (NGOs) or even popular disaster movies in the cinema. Moreover, people from developing and developed countries may have different concerns and led to different learning outcomes. Murakami et al., 2017, for example, reported that people in developed countries would have a higher environmental awareness of human health, biodiversity, and primary production. On the other hand, the news of famine and hunger, compared with other SDGs, would attract more attention from all over the world (De-Waal, 2017; Banik and Chasukwa, 2019) and raised enough awareness among students before the eTournament.

TABLE 4 | Independent-sampled *t*-test between students in first and second eTournament.

	Mean (first eTournament, N = 99)	Mean (second eTournament, N = 118)	p-Value
Level of Enjoyment	3.09	4.06	0.00
Perceived improvement of SDG awareness	2.98	4.40	0.00
Frequency of question-attempt	114.4	170.7	0.00

TABLE 5 | Paired-sampled *t*-test of Students' Global perspectives in Pre- and Post-survey.

	Mean-difference	t-Value	p-Value
Cognitive knowing	-0.06	1.14	0.256
Cognitive knowledge	0.03	-0.98	0.329
Intrapersonal identity	0.00	0.04	0.970
Intrapersonal affect	-0.19	4.22	0.000
Interpersonal social interaction	0.04	0.73	0.456

By contrast, the SDGs about perceptual domains, such as SDG 17 “Partnerships for the Goals” and 16 “Peace, Justice and Strong Institutions,” were more complicated to be understood by the general public in daily life. Compared with the environmental issues, which were often portrayed in different disaster and action movies (Keane, 2006), the universal value (i.e., peace or justice) and global partnership may be less attractive to audience or more difficult to form intriguing storylines. Therefore, the students in these SDGs may receive greater shocks and perceived improvement of awareness during the gameplay.

Second, the comparison between the first and second eTournament in *Findings* showed that the students with greater autonomy in selecting their own SDG questions would have a significantly higher level of enjoyment, greater improvement of SDG awareness, and more question-attempt during the gameplay. It indicates that the game designer should pay more attention to the user's autonomy in selecting questions as it could greatly improve the attractiveness of gameplay.

Third, another point of view on students' varying levels of understanding of these SDGs may be related to recent criticisms.

The SDGs were recognized as being too complicated, inconsistent, and containing buzzwords without detailed definitions, such as “resilience” and “sustainable” (Liverman, 2018). In addition, in some SDGs, such as SDG 8 “Decent Work and Economic Growth” and SDG 10 “Reducing Inequality,” there are certain conflicts such as boosting economic growth for the bottom 40%, without considering the impact on the SDGs relating to the environment and reducing inequality by redistributing the top 1%'s income (Liverman, 2018). This could make it difficult for learners to master these topics.

The Effectiveness of eTournament in Promoting Students' Global Perspective

Regarding the effectiveness of the eTournament on promoting students' global perspective, the result is somewhat surprising. Following the eTournament, students' levels of intrapersonal effect were found to be significantly lower. It is probably because most university students have overestimated their self-openness to other cultures before real multicultural collaboration.

During the eTournament, the students would realize the incompatible views or different working styles of other team members. They have to manage unexpected cultural conflicts or even experience cultural shock during the interaction. Through the discussion process, the student could gain better self-understanding and identify their weakness in intercultural interaction.

In the age of globalization, however, university students should take risks and face challenges before they engage with foreigners as early as possible. It is the only way to enable students to develop advanced social skills and to manage the intercultural conflict through real intercultural interaction experiences, although such intercultural experience may not always be comfortable.

TABLE 6 | Independent-sampled *t*-test of Students' Global perspectives between first and second eTournament.

	Mean-difference before and after tournament (first eTournament, N = 99)	Mean-difference before and after tournament (second eTournament, N = 111)	t-Value	p-Value
Cognitive knowing	0.105	-0.188	3.26	0.00
Cognitive knowledge	-0.059	0.058	-1.56	0.12
Intrapersonal identity	-0.074	0.024	-1.12	0.26
Intrapersonal affect	-0.498	-0.225	-2.85	0.01
Interpersonal social interaction	-0.283	0.144	-4.15	0.00

Level of enjoyment and perceived improvement of SDG awareness in 17 SDGs

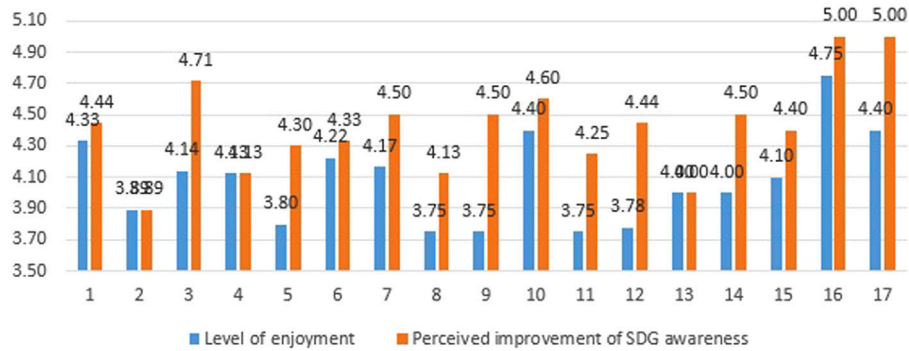


FIGURE 4 | Level of enjoyment and perceived improvement of SDG awareness in 17 SDGs.

Frequency of question-attempt in 17 SDGs

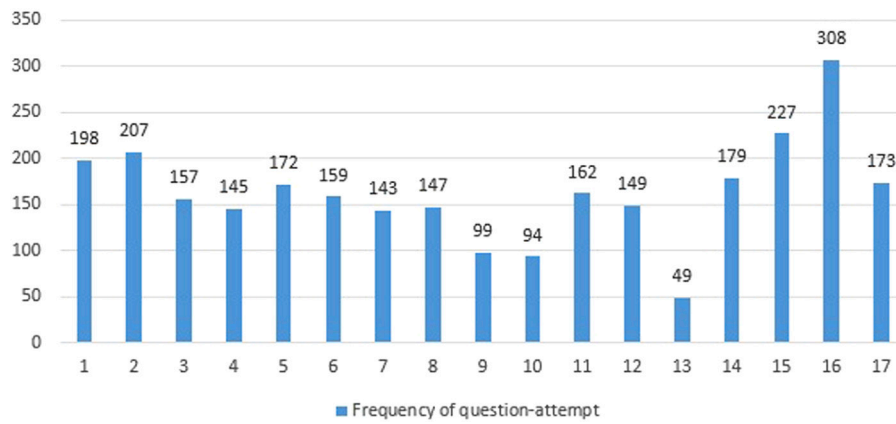


FIGURE 5 | Frequency of question attempts in 17 SDGs.

Change of global perspectives before and after the eTournament

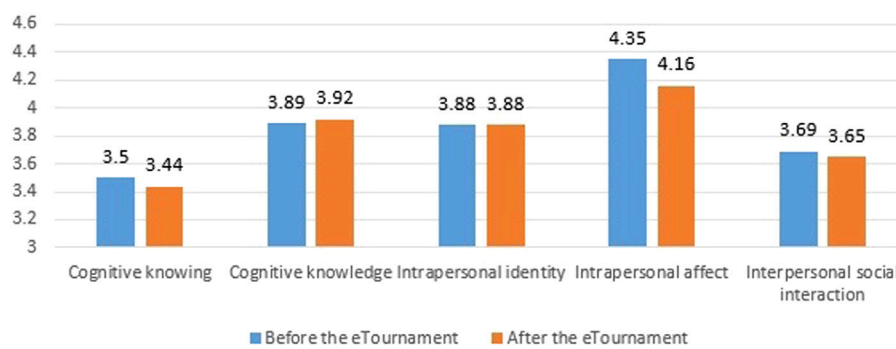


FIGURE 6 | Change of global perspectives before and after the eTournament.

TABLE 7 | Correlation between students' global perspective, level of enjoyment, improved SDG awareness, and frequency of question attempts.

	Level of enjoyment	Perceived improvement of SDG awareness	Frequency of question-attempt
Change of Cognitive knowing	0.002	-0.078	0.095
Change of Cognitive knowledge	0.167*	0.124	0.250*
Change of Intrapersonal identity	0.067	0.079	0.167
Change of Intrapersonal affect	0.199*	0.111	0.265*
Change of Interpersonal social interaction	0.177*	0.239	0.211*

Note (*) p-value is less than or equal to 0.05.

Correlation Between the Students' Gameplay Experience and the Global Perspective

The findings show that the eTournament could meet our learning objective, where students could gain more understanding and awareness of various cultures and their impact on our global society through more frequent gameplay. Moreover, the gameplay could also help students build up respect and acceptance to others with multicultural perspectives, as well as a higher level of emotional intelligence and cultural sensitivity for the unknown cultural conflict in the future.

In the eTournament, however, there are some limitations to the game design that we should be aware of. First, the eTournament could not help students to recognize the importance of cultural contexts or judge what the key knowledge or value in different SDGs is. It is also evident in our correlation test in **Table 7**, where no correlation is observed between the "change of cognitive knowledge" and all three variables about students' gameplay experience. It also indicates that the student participants could not develop the perspective-taking ability that concerned other's unique identity after the eTournament. This is due to the fact that the tasks in this eTournament are rather simple and straightforward in the form of MCQ, and the students do not have to deal with complicated tasks during team collaboration.

Moreover, the results show that the perceived improvement of SDG awareness is not necessarily consistent with the students' global perspective. It indicates that the development of students' global perspective and students' awareness about SDG issues should be considered as two non-correlated variables. In other words, a multicultural team with stronger global perspectives would not guarantee a higher level of awareness about SDG. It is quite different from the traditional view that students with stronger global perspectives could have better quality collaboration with intercultural peers, and leads to more successful outcomes (Leinonen et al., 2005). It supports the suggestion of Leinonen and her colleagues that there is a need to investigate students' awareness of collaboration in more detail, including 1) awareness of the collaboration possibility, 2) awareness of the collaboration purpose, and 3) awareness of the collaboration process. It calls for the need to further explore the students' subjective perception and interpretation

in the future, which may explain the missing link between multicultural collaboration and the expected learning outcomes, as shown in our study.

CONCLUSION AND THE WAY FORWARD

This study revealed that students' gameplay experience of the eTournament could contribute to their global perspective development. Regarding the impact of eTournament on 17 SDGs, the findings showed that students were satisfied with the level of enjoyment ($M = 3.62$) and perceived improvement of SDG awareness ($M = 3.75$) on average, while it was found to be particularly effective in improving perceptual dimensions of global perspectives in terms of issues about universal values (i.e., SDG 16 "Peace and Justice and Strong Institutions" and structured issues that involved multinational cooperation (e.g., SDG 17 "Partnerships for the Goals" or 3 "Good health and well-being." By contrast, the substantial dimensions (e.g., SDG 2 "Zero Hunger") or environmental issues SDG 13 "Climate Action"), were less likely to receive benefit from eTournament.

At the individual level, the findings showed that students become more aware of the difficulties of intercultural collaboration, such as integrating one's personal values and self-identity into one's personhood. It is reflected in the decrease of "intrapersonal affect" after the eTournament, which indicates that students have re-estimated their level of respect for and acceptance of other cultural perspectives after the eTournament. It is believed that the students' experience in the eTournament could serve as a foundation for their future intercultural interactions towards a more comprehensive global perspective.

This study also examined which elements of gameplay contributed to most of the students' global perspectives development. The findings revealed that the level of students' cognitive knowledge and interpersonal social interaction was positively related to their level of enjoyment and frequency of question attempts. It helps future game designers and course instructors to realize the importance of motivating students' learning through gameplay experience and imposing more enjoyable elements to develop broader perspectives about the world.

From the instructors' point of view, this study gave insights into addressing the students' needs for different global issues. Before advocating the importance of global perspectives, it is better for universities to explore which global perspectives are

better off for their online learning environment and which ones are not. For example, the findings of this study reveal that the students' awareness of SDG 3 "Good health and well-being", 16 "Peace, Justice and Strong Institutions," and 17 "Partnerships for the Goals" received the greatest improvement. The instructors could further explore more possibilities in their development in other game-based learning environments.

Second, as illustrated by the findings, despite most students reporting a satisfactory level of enjoyment and improvement in SDG awareness on average, the correlation is only observed between the change of global perspective, frequency of question-attempt, and level of enjoyment. This implies that game designers or instructors should show more concern about how to optimize the combination of gamified elements and the learning content when promoting students' global perspectives development.

The lack of identification of global perspectives among the participants through a qualitative approach is one of the limitations of this research. Despite the fact that the quantitative results showed students' learning gains and attitudes in this eTournament, there were no in-depth examinations to aid in the analysis of these results. As a result, future studies may concentrate on a different angle of inquiry, such as document reviews and content analysis similar to what McCabe, 1994 proposed, to identify the dimensions among these students' global perspectives. Another drawback of this study was that the research findings suggested that allowing students to self-select SDG question sets in the eTournament may lead to increased motivation on learning the SDGs. Despite the results suggesting this rationale, there has been no further investigation into the exact point of students' shifts in attitude in a more valid manner.

In conclusion, this study reveals the possibility of developing students' global perspectives through a gamified e-learning platform. In the future, global education should begin to move from just an internationalized curriculum in the traditional classroom into the digital platform providing an opportunity to build up more in-depth global perspectives among students with multidisciplinary and multicultural backgrounds.

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DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because they involve the privacy of individuals. Requests to access the datasets should be directed to FL, yickwah@hkbu.edu.hk.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Hong Kong Baptist University. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

The first author conducted the literature review and wrote the manuscript with support from all other authors. The second author verified the data and supported the preparation of graphs and figures. The third author assisted with the revisions to the manuscript according to the reviewer's comments. All authors contributed to the design and implementation of the research.

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